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Citation for published version:

Kutlubaev, MA, Xu, Y, Hackett, ML & Stone, J 2018, 'Dual diagnosis of epilepsy and psychogenic nonepileptic seizures: Systematic review and meta-analysis of frequency, correlates, and outcomes', *Epilepsy & Behavior*, vol. 89, pp. 70-78. <https://doi.org/10.1016/j.yebeh.2018.10.010>

Digital Object Identifier (DOI):

[10.1016/j.yebeh.2018.10.010](https://doi.org/10.1016/j.yebeh.2018.10.010)

Link:

[Link to publication record in Edinburgh Research Explorer](#)

Document Version:

Peer reviewed version

Published In:

Epilepsy & Behavior

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Dual diagnosis of epilepsy and psychogenic non-epileptic seizures: systematic review and meta-analysis of frequency, correlates and outcomes

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Author contributions: MK searched reference lists, extracted the data and wrote first draft. YX searched databases and performed statistical analysis. All authors take part in the planning of the paper, critically reviewed, revised and approved the final draft.

Key words: epilepsy, non-epileptic psychogenic seizure, comorbidity, dual diagnosis, dissociative seizure

Number of text pages – 7

Number of words (summary) - 215

Number of words (main text) - 3065

Number of tables – 3

Number of figures - 3

Abstract

Comorbid epilepsy and psychogenic non-epileptic seizures (PNES) represent a serious challenge for the clinicians. However the frequency, associations and outcomes of dual diagnosis of epilepsy and PNES are unclear.

The aim of the review was to determine the frequency, correlates and outcomes of a dual diagnosis. A systematic review of all published observational studies (from inception to Dec 2016) was conducted to determine the frequency, correlates and outcomes of dual diagnosis. We included studies of individuals of any age reporting a dual diagnosis of epilepsy and PNES. All observational study designs were included with the exception of case-reports and case series with fewer than 10 participants.

The mean frequency of epilepsy in patients with PNES across all studies was 22% (95% confidence intervals [CI] 20 to 25%, range 0 % to 90 %), while the mean frequency of PNES in patients with epilepsy was 12% (95% CI 10 to 14%, range 1% to 62%). High heterogeneity means that these pooled estimates should be viewed with caution. A number of correlates of dual diagnosis were reported. Some studies delineated differences in semiology of seizures in patients with dual diagnosis vs. PNES or epilepsy only. However, most of the correlates were inconclusive. Only a few studies examined outcome in patients with dual diagnosis.

Dual diagnosis is common in clinical practice, especially among patients referred to specialized services, and requires careful diagnosis and management.

Key words: epilepsy, non-epileptic psychogenic seizure, comorbidity, dual diagnosis, dissociative seizure; psychogenic

1.Introduction

Psychogenic non-epileptic seizures (PNES) are genuinely experienced events resembling epilepsy but without the concomitant electrophysiological electrical activity¹. The clinical presentation of PNES and epilepsy can be similar. However, approaches to their management are radically different. Epilepsy requires anticonvulsant therapy, in certain cases surgery and other non-pharmacological methods, while modern etiological models of PNES find that it has much in common with panic disorder and can benefit in a similar way from explanation and psychotherapeutic interventions².

In some cases, PNES and epilepsy coexist. According to different estimates, between 8% and 60% of patients with PNES also have epilepsy³. A number of factors could contribute to the development of PNES in epilepsy such as psychiatric comorbidities, cognitive dysfunction, the experience of unpredictable seizures and problems with social adaptation⁴.

To our knowledge there is no systematic review exploring the frequency, associations and outcomes of comorbid epilepsy in patients with PNES and vice versa. These data are important for early identification of those who are at risk of the development of comorbid epilepsy and PNES and planning treatment. The aim of the review is to determine the frequency, correlates and outcomes of dual diagnosis of epilepsy and PNES.

2. Methods

The systematic review was undertaken following MOOSE guidelines⁵ for meta-analysis of observational studies and reported following the PRISMA guidelines⁶.

2.1. Search strategy and data extraction

Five databases were searched: MEDLINE, EMBASE, PsycINFO, CINAHL and AMED (from inception to 11 Dec 2016). The following search terms were used as free text or controlled vocabulary (i.e. medical subject headings, Emtree) as appropriate for each database: 'epilepsy' AND 'seizure', 'attack', 'non-epileptic', 'psychogenic', 'dissociative', 'conversion', 'functional' (full details available in the supplementary file). Titles and abstracts of all references were screened by one author (YX) and full text articles were examined by another (MK) to determine whether they met the inclusion criteria. Further literature was sought through the reference lists of eligible studies (MK). Data extraction included region/country, recruitment site, study period, age, sample size, frequency of dual diagnosis, method of diagnosis and who made the diagnosis. One researcher (MK) extracted data. When abstracts from conferences were identified, we sought corresponding published journal articles. We reported data from the abstracts only if corresponding journal articles could not be identified. We judged articles to be from the same cohort if there was evidence

of overlapping recruitment sites, study dates, authorship and similar patient characteristics. We included all published observational studies reporting the frequency of people with dual diagnosis of epilepsy and PNES or associations of comorbid epilepsy and PNES as a primary or secondary outcome regardless of duration of the disease. All observational study designs were accepted with the exception of case-report and case series of fewer than 10 participants.

All studies were divided into high and low-quality groups. The studies were qualified as low-quality if they had either specific participant characteristic limits such as one sex, disabled, but not age, or convenience, selective or random sampling. Risk of bias was assessed using a 10-item assessment which reflected quality criteria for such studies ⁷.

Statistical analysis. Studies' reported frequency of comorbid epilepsy and PNES were pooled. We conducted quantitative synthesis and produced forest plots in Stata 13 using random effects analysis. Subgroup analysis was conducted based on the recruitment site (i.e. specialized centers; neuropsychiatry units, psychiatry departments, neuropsychology units; hospitals; populations based; databases) and study population (i.e. adults, adults in epilepsy surgery series, children, adults, veterans, intractable seizures, elderly). Statistical heterogeneity and consistency were assessed using the standard Q statistic, with $P < 0.05$ and I^2 .

3. Results.

The search results and selection processes are summarized in Figure 1. A total of 2773 references were identified, of which 175 full text articles were retrieved to assess for inclusion/exclusion and a total of 118 studies (122 reports) were considered eligible. Included papers contained data obtained from 17,478 people. Two studies were population-based ^{8 9}, while the rest were hospital-based ^{1 3 4 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100 101 102 103 104 105 106 107 108 109 110 111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126}. In the latter, patients were recruited mostly from highly specialized epilepsy centers (tertiary hospitals, academic departments, comprehensive epilepsy programs - 112 of 118 studies). Sixty-nine studies were retrospective and 49 were prospective. Children were recruited in seven studies, three of which specifically included those with intractable seizures. In one study, patients with juvenile myoclonic epilepsy of different ages were included. One hundred and nine studies were restricted to adults, of which some were exclusively of specific subpopulations: elderly or veterans (n=7), surgical series (n=6), treatment resistant epilepsy (n=5), “mental retardation” (n=1) and traumatic brain injury (n=1). In 72 studies, patients with dual diagnosis were compared to those with PNES. In 21 studies, patients with dual diagnosis were compared with those with PNES and

with epilepsy. The method of diagnosis of epilepsy/PNES was video-EEG-monitoring (VEM) in 102 of 118 studies.

3.1. Frequency of dual diagnosis.

The frequency of epilepsy in patients with PNES varied from 0 % to 90 %, while the frequency of PNES in patients with epilepsy varied from 1% to 62%.

The pooled frequency of epilepsy among those with PNES was 22% (95% confidence interval [CI] 20 to 25%) (Fig. 2). The pooled frequency of PNES among those with epilepsy was 12%; 95% CI 10 to 14%) (Fig. 3). In both cases the level of heterogeneity (I^2) of included studies was high i.e. 96.5 and 92.7 % correspondingly, $p=0,0001$.

Meta-analysis of the data according to the site of recruitment yielded similar results. The pooled frequency of dual diagnosis varied from 2% (95% CI 1 to 4%) among those recruited from epilepsy surgery programs (3 studies, $n=2872$) up to 42% (95% CI 11 to 72%) among patients from (neuro)psychiatric departments and neuropsychology units (3 studies, $n=161$). In the two population-based studies, the pooled frequency of epilepsy among those with PNES (2 studies, $n=833,527$) was 14% (95% CI 4 to 23%)^{9 8}, and the frequency of PNES among those with epilepsy was 17% in a single study⁹.

3.2. Demographic features.

There were no differences between those with dual diagnosis, PNES and epilepsy in aspects of age, age at disease onset, disease duration, sex, marital or educational status (see Table 1).

3.3. History details.

Patients' history of physical or sexual abuse, abuse in childhood, significant head trauma, and substance abuse, were similar among patients with dual diagnosis and PNES in all five^{12 47 56 17 72} studies reported this. It did not differ among patients with dual diagnosis and epilepsy in two^{17 72} out of three^{17 72 26} studies.

3.4. Seizure characteristics and medication.

Non-epileptic seizure characteristics were assessed in ten studies with eight finding differences in semiology of seizures between those with PNES and dual diagnosis. Stiffening of the body (60% vs. 37% $p>0.05$)¹², opisthotonus (18.5% vs. 0%, $p>0.03$)⁵⁶, convulsive behavior (85% vs. 55.5% $p>0.05$)⁴⁷, right-hemibody PNES events (7% vs. 23%; $p = 0.054$)⁷⁷, autonomic symptoms/signs during the seizure (51.6% vs. 23.7% $p=0.03$)^{27 99}, postictal state (84% vs. 58% $p=0.02$)¹² were more common in patients with PNES than those with dual diagnosis. Total lack of responsiveness

(63% vs. 25% $p < 0.05$)¹⁸ and myoclonic seizure semiology (10% vs. 2%; $p = 0.073$)⁷⁷ were observed more often in patients with dual diagnosis than in those with PNES. Absence/staring seizures were less common in dual diagnosis in comparison to ES patients (9% vs. 41%; $p = 0.003$)⁷⁷.

The median seizure frequency was significantly higher in the patients with dual diagnosis than in those with PNES (for instance 30 (range 2 to 500) vs. 125 (range 1 to 1000) seizures per year⁴⁷) in two^{31 47} of three studies, but, in one study, this held only before the diagnosis of PNES⁴⁷.

As expected, patients with dual diagnosis had higher AED use than patients with PNES (5 studies^{17 33 47 40 126}) and in one study lower AED use than in epilepsy¹⁷. Patients with PNES took more psychotropic drugs than AED in one study³³.

3.5. Miscellaneous clinical features.

Two studies explored possible association between dual diagnosis and medical comorbidities. One study (n=689), showed that patients with dual diagnosis in comparison to those with epilepsy more often smoked, suffered from pain, asthma, gastroesophageal reflux disease and migraine, while another one (n=188)¹² reported no association.

In one small study (n=20), the authors suggested an interesting way of classifying patients with dual diagnosis into three groups: i) resistant epilepsy with anxiety/depression and normal cognition, ii) learning difficulties and dependent personality, iii) comorbid cluster B personality disorders, anxiety disorders, psychic trauma and normal cognition. However, the small numbers meant this was only a hypothesis generating study⁴.

3.6. EEG and neuroimaging

As expected, patients with dual diagnosis, in comparison to those with PNES, more often had abnormalities on EEG^{109 33 61 91}. They were less susceptible to EEG induction procedures in one study⁴⁰. Temporal lobe epilepsy was equally common in patients with epilepsy and dual diagnosis according to the biggest study of its kind (n=1488)⁸⁸, while smaller studies yielded conflicting results (Table 3).

3.7. Psychiatric comorbidity and neuropsychological features.

Most researchers used DSM-IV criteria for diagnosing psychiatric comorbidities^{72 18 47}, however there was no consistent approach across researchers to the assessment or categorization of neuropsychological features. At most, specific neuropsychological features were explored in no more than three studies making an overall summary difficult.

Generally researchers did not find a difference between PNES and dual diagnosis in psychiatric morbidity^{56 72 47} or suicide attempts¹⁸. In three studies, patients with PNES and dual diagnosis experienced more behavioral problems than patients with epilepsy^{84 49 27}.

Compared to patients with PNES, patients with dual diagnosis more often experienced affective and personality disorders^{26 58}, but less often had PTSD and dissociative disorder^{58 18} (Table 3). Using the Minnesota Multiphasic Personality Inventory patients with dual diagnosis, compared to patients with epilepsy, scored more highly on the 'hysteria'^{17 122 86}, 'lassitude-malaise' and 'mental dullness' scales¹⁷. On 'hypochondriasis' and 'depression' scales, they scored lower than PNES patients in one study⁸⁶.

Five studies^{87 72 62 91 25} assessed cognitive function in patients with PNES and/or epilepsy and dual diagnosis and yielded conflicting results. Two out of four studies reported significant differences in cognitive functions between patients with PNES and dual diagnosis^{87 91}, two found that cognitive changes could predict coexistence of PNES in epilepsy^{62 25}, while one reported similar cognitive status for patients with dual diagnosis, PNES and epilepsy⁷².

3.8. Employment and disability status

Employment status did not differ among patients with dual diagnosis and PNES in two studies^{58 47}. Disability status and length of medical care for the seizure disorder were analyzed in four studies, which yielded conflicting results.^{26 77 17 126}

3.9. Outcomes in patients with dual diagnosis.

Unfavorable outcomes in the dual diagnosis group were reflected in a greater number of emergency department visits in comparison to epilepsy¹⁵ more frequent hospital visits⁵⁶ and rarer achievement of remission than in those with PNES⁷⁸.

Two studies demonstrated that detection of dual diagnosis could improve subsequent outcomes in those patients^{56 13}. After diagnosis of PNES, psychogenic events more often ceased in the dual diagnosis group as opposed to PNES group in one study (22% vs 58%)⁵⁶.

4. Discussion

Dual diagnosis is more frequent in this systematic review than previously reported³. This could be explained partly by the recruitment of patients in most studies from specialized epilepsy centers where complex and unusual cases concentrate. However, this relatively high frequency of dual diagnosis was also shown in two population-based studies suggesting that it is also common in overall populations of patients primarily diagnosed with epilepsy or PNES.

The lowest frequency of dual diagnosis was registered in surgical series (2%) which is probably explained by careful pre-surgical examination and exclusion of most of the patients with comorbid PNES. In contrast, the highest frequency of dual diagnosis was observed among patients referred to (neuro)psychiatry/neuropsychology units (42%), which probably reflects factors leading to referral to those services. This finding emphasizes the importance of considering the recruitment setting when looking at comorbidities.

Dual diagnosis was almost twice as frequent in the studies recruiting people with PNES than in the studies recruiting those with epilepsy. It could be that a certain proportion of the patients with epilepsy developed PNES, which then predominated in the clinical picture; such a pattern is common in our experience.

Demographic features of patients with dual diagnosis, PNES and epilepsy were similar. Despite some differences in individual studies, no consistent or specific semiological signs of dual diagnosis, were found which may differentiate it from patients who had PNES or epilepsy alone.

Varying findings on psychiatric comorbidities and neuropsychological correlates in patients with dual diagnosis reflect the clinical heterogeneity of this phenomenon. On the other hand, only some authors performed formal psychiatric evaluation to assess psychiatric comorbidities, whilst the rest used only psychometric scales, which could be considered as a limitation of those studies. There are several potential overlapping mechanisms of the development of PNES in epilepsy. These include a) anxiety and other psychiatric comorbidity arising from the experience of epilepsy; b) the way in which epilepsy may act as a ‘symptom scaffold’ on which is built a recurrent conditioned response to arousal² c) as an involuntary substitute symptom especially in an intellectually disabled population and after successful surgery for epilepsy. In the latter case reduction in epileptic seizure frequency leads to the develop of PNES driven by secondary gains such as caregiver attention or activity avoidance⁴. The development of PNES after epilepsy surgery could be not only “compensatory”, but also a result of psychological stress associated with the operation^{63 60}.

Very few studies assessed outcomes in patients with dual diagnosis. Some data showed that dual diagnosis predisposes patients to worse outcomes, but once the correct diagnosis is made, the number of events and number of AED is likely to decrease. This emphasizes the importance of timely diagnosis of PNES in epilepsy patients.

In clinical practice, the data suggest that patient with treatment-resistant epilepsy is at higher risk of developing of PNES, and vice versa. The dual diagnosis should be considered in the cases of the unexpected development of new seizure types or increase in their frequency. Correctly identifying dual diagnosis is typically harder than isolated PNES, and especially recording both types of events on VEM. In some cases, details from the patient’s history can be misleading. For instance, mild

traumatic brain injury is a risk factor for the development of not only epilepsy, but also posttraumatic stress disorder and PNES ¹²⁷. On the other hand, although stress and adverse experience are considered established risk factors for the development of PNES in some individuals, they can also contribute to the development/exacerbation of epilepsy ^{128 129}.

This systematic review had several limitations. We included studies regardless how PNES, epilepsy and dual diagnosis were identified. In the majority of cases, the diagnosis was confirmed by VEM, whilst some authors used more relaxed diagnostic criteria. There was a high degree of heterogeneity between the studies which even a random effects meta-analysis may not have compensated for. Nonetheless we think the meta-analysis has some face validity in describing the published literature although summary values should be interpreted with caution. We also did not evaluate publication bias. There are likely to be other series of patients with ES, where PNES was not a focus of the study title or abstract but it is recorded as a comorbidity. We were not able to analyze studies in relation to the frequency of intellectual disability within individual studies, as this data was rarely available. Clinical experience suggests that patients with intellectual disability have a particularly high rate of dual diagnosis. Methodological limitations of some studies could also affect the dual diagnosis. For instance, provocative tests (verbal suggestion, saline injection) were used in 2 studies during VEM, and in some studies the ‘criteria for epileptiform discharges’ were not clearly described. None of the studies presented a priori power calculations for the sample size.

Future research could attempt to build on the categorization of patients with dual diagnosis of PNES and epilepsy under different subtypes depending on mechanisms of development and clinical features. Thus far, there is no work studying effective treatment of PNES in those with dual diagnosis as they tend to be excluded from clinical trials of AEDs. Clinicians working in this area tend to adopt a model of treatment, which focuses on helping patients, and their family identify individual seizure types and then treat accordingly. An additional element of therapy in those patients can involve a focus on understanding the hypothesized mechanisms of association described above. PNES are so common in certain patients with epilepsy (those with cognitive decline, affective disorders etc.) that it begs the question of whether pre-emptive education or psychological interventions are warranted and may be helpful in those high-risk groups?

5. Conclusion.

Dual diagnosis is relatively common among those diagnosed with PNES or epilepsy, especially in those who referred to specialized epilepsy centers. This indicates the importance of considering this comorbidity, not only in patients with PNES but also in a population with epilepsy. Future research should pursue potential mechanisms of the development of PNES in epilepsy, describe

individual risk factors and test possible interventions for the treatment and possibly early detection and prevention of the development of PNES in patients with epilepsy.

We confirm that we have read the Journal's position on issues involved in ethical publication and affirm that this report is consistent with those guidelines.

Neither of the authors has any conflict of interest to disclose.

Acknowledgements: During the completion of this work Ying Xu held the University of Sydney Postgraduate Award, Maree L. Hackett held a National Heart Foundation Future Leader Fellowship, Level 2 (100034, 2014–2017) and a National Health and Medical Research Council Career Development Fellowship, Level 2 (APP1141328 2018-2021), Jon Stone was supported by a National Research Scotland Career Fellowship.

The authors want to thank the following researchers at the George Institute for their language assistance: Brendan Smyth (Italian), Laurent Billot (French), Veronika Olajcova (Czech), Zeljka Calic (Serbian), Cindy Kok (Dutch), Sohei Yoshimura and Toshiaki Ohkuma (Japanese). The authors also thank Jayne O'Hare, a librarian from the University of Sydney for her assistance in building up the searching strategies.

References

1. Chen JJ, Callier TA, Mecchella JN et al. Reducing severity of comorbid psychiatric symptoms in an epilepsy clinic using a colocation model: Results of a pilot intervention. *Epilepsy Behav.* 2014;39:92-96.
2. Brown RJ, Reuber M. Towards an integrative theory of psychogenic non-epileptic seizures (PNES). *Clin Psychol Rev.* 2016;47:55-70.
3. Benbadis SR, Agrawal V, Tatum WO. How many patients with psychogenic nonepileptic seizures also have epilepsy? *Neurology.* 2001;57:915-917.
4. Magaudda A, Gugliotta SC, Tallarico R et al. Identification of three distinct groups of patients with both epilepsy and psychogenic nonepileptic seizures. *Epilepsy Behav.* 2011;22:318-323.
5. Stroup DF, Berlin JA, Morton SC et al. Meta-analysis of Observational Studies in Epidemiology: A Proposal for Reporting. *JAMA.* 2000;283:2008-2012.
6. Moher D, Liberati A, Tetzlaff J et al. Preferred reporting items for systematic reviews and meta-analyses: The PRISMA statement. *PLoS Med.* 2009;6:e1000097.

7. Quality Assessment Tool for Observational Cohort and Cross-Sectional Studies. Available at: <https://www.nhlbi.nih.gov/health-topics/study-quality-assessment-tools>. Accessed March 1, 2018.
8. Szaflarski JP, Ficker DM, Cahill WT et al. Incidence of nonepileptic seizures in Hamilton County, OH. *Neurology*. 2000;55:1561-1563.
9. Sigurdardottir KR, Olafsson E. Incidence of psychogenic seizures in adults: A population-based study in Iceland. *Epilepsia*. 1998;39:749-752.
10. Alessi R, Vincentiis S, Rzezak P et al. Semiology of psychogenic nonepileptic seizures: Age-related differences. *Epilepsy Behav*. 2013;27:292-295.
11. Anderson J, Hill J, Alford M et al. Healthcare resource utilization after medium-term residential assessment for epilepsy and psychogenic nonepileptic seizures. *Epilepsy Behav*. 2016;62:147-152.
12. Asadi-Pooya AA, Emami M. Demographic and clinical manifestations of psychogenic non-epileptic seizures: The impact of co-existing epilepsy in patients or their family members. *Epilepsy Behav*. 2013;27:1-3.
13. Baheti NN, Radhakrishnan A, Radhakrishnan K. A critical appraisal on the utility of long-term video-EEG monitoring in older adults. *Epilepsy Res*. 2011;97:12-19.
14. Bayly J, Carino J, Petrovski S et al. Time-frequency mapping of the rhythmic limb movements distinguishes convulsive epileptic from psychogenic nonepileptic seizures. *Epilepsia*. 2013;54:1402-1408.
15. Caller TA, Chen JJ, Harrington JJ et al. Predictors for readmissions after video-EEG monitoring. *Neurology*. 2014;83:450-455.
16. Cervenka MC, Lesser R, Tran TT et al. Does the teddy bear sign predict psychogenic nonepileptic seizures? *Epilepsy Behav*. 2013;28:217-220.
17. Cragar DE, Schmitt FA, Berry DTR et al. A Comparison of MMPI-2 Decision Rules in the Diagnosis of Nonepileptic Seizures. *J Clin Exp Neuropsychol*. 2003;25:793-804.
18. D'Alessio L, Giagante B, Oddo S et al. Psychiatric disorders in patients with psychogenic non-epileptic seizures, with and without comorbid epilepsy. *Seizure*. 2006;15:333-339.
19. Davies KG, Blumer DP, Lobo S et al. De Novo Nonepileptic Seizures after Cranial Surgery for Epilepsy: Incidence and Risk Factors. *Epilepsy Behav*. 2000;1:436-443.
20. De Timary P, Fouchet P, Sylin M et al. Non-epileptic seizures: Delayed diagnosis in patients presenting with electroencephalographic (EEG) or clinical signs of epileptic seizures. *Seizure*. 2002;11:193-197.
21. Desai D, Desai S, Jani T. Juvenile Myoclonic Epilepsy in Rural Western India: Not Yet a Benign Syndrome. *Epilepsy Res Treat*. 2016;2016:1435150.

22. Devinsky O, Sanchez-Villaseñor F, Vazquez B et al. Clinical profile of patients with epileptic and nonepileptic seizures. *Neurology*. 1996;46:1530-1533.
23. Dhiman V, Sinha S, Rawat VS et al. Semiological characteristics of adults with psychogenic nonepileptic seizures (PNESs): An attempt towards a new classification. *Epilepsy Behav*. 2013;27:427-2.
24. Dhiman V, Sinha S, Rawat VS et al. Children with psychogenic non-epileptic seizures (PNES): A detailed semiologic analysis and modified new classification. *Brain Dev*. 2014;36:287-3.
25. Duncan R, Oto M. Predictors of antecedent factors in psychogenic nonepileptic attacks: Multivariate analysis. *Neurology*. 2008;71:1000-1005.
26. Elliott JO, Charyton C. Biopsychosocial predictors of psychogenic non-epileptic seizures. *Epilepsy Res*. 2014;108:1543-1553.
27. Galimberti CA, Teresa Ratti M, Murelli R et al. Patients with psychogenic nonepileptic seizures, alone or epilepsy-associated, share a psychological profile distinct from that of epilepsy patients. *J Neurol*. 2003;250:338-346.
28. Glosser G, Roberts D, Glosser DS. Nonepileptic seizures after resective epilepsy surgery. *Epilepsia*. 1999;40:1750-1754.
29. Gordon PC, Valiengo LDCL, Proença ICGF et al. Comorbid epilepsy and psychogenic non-epileptic seizures: How well do patients and caregivers distinguish between the two. *Seizure*. 2014;23:537-541.
30. Hamid H, Fodeh SJ, Lizama AG et al. Validating a natural language processing tool to exclude psychogenic nonepileptic seizures in electronic medical record-based epilepsy research. *Epilepsy Behav*. 2013;29:578-580.
31. Hara K, Adachi N, Akanuma N et al. Dissociative experiences in epilepsy: Effects of epilepsy-related factors on pathological dissociation. *Epilepsy Behav*. 2015;44:185-191.
32. Herskovitz M. Psychogenic Nonepileptic Seizure Patterns in Patients With Epilepsy. *Psychosomatics*. 2015;56:78-84.
33. Hoepner R, Labudda K, May TW et al. Distinguishing between patients with pure psychogenic nonepileptic seizures and those with comorbid epilepsy by means of clinical data. *Epilepsy Behav*. 2014;35:54-58.
34. Jones SG, O'Brien TJ, Adams SJ et al. Clinical characteristics and outcome in patients with psychogenic nonepileptic seizures. *Psychosom Med*. 2010;72:487-497.
35. Kalogjera-Sackellares D, Sackellares JC. Intellectual and neuropsychological features of patients with psychogenic pseudoseizures. *Psychiatry Res*. 1999;86:73-84.
36. Kellinghaus C, Loddenkemper T, Dinner D et al. Non-epileptic seizures of the elderly. *J*

Neurol. 2004;251:704-709.

37. Kipervasser S, Neufeld MY. Video-EEG monitoring of paroxysmal events in the elderly. *Acta Neurol Scand.* 2007;116:221-225.
38. Marchetti RL, Kurcgant D, Neto JG et al. Evaluating patients with suspected nonepileptic psychogenic seizures. *J Neuropsychiatry Clin Neurosci*, 2009;21:292-8.
39. Martin R, Burneo J, Prasad A, et al. Frequency of epilepsy in patients with psychogenic seizures monitored by video-EEG. *Neurology* 2003;61:1791-1792.
40. Mari F, Di Bonaventura C, Vanacore N et al. Video-EEG study of psychogenic nonepileptic seizures: Differential characteristics in patients with and without epilepsy. *Epilepsia.* 2006;47(Suppl. 5):64-67.
41. Massot-Tarrús A, McLachlan RS. Marijuana use in adults admitted to a Canadian epilepsy monitoring unit. *Epilepsy Behav.* 2016;63:73-78.
42. Metrick ME, Ritter FJ, Gates JR et al. Nonepileptic Events in Childhood. *Epilepsia.* 1991;32:322-328.
43. Müller T, Merschhemke M, Dehnicke C et al. Improving diagnostic procedure and treatment in patients with non-epileptic seizures (NES). *Seizure.* 2002;11:85-89.
44. Neill JC, Alvarez N. Differential diagnosis of epileptic versus pseudoepileptic seizures in developmentally disabled persons. *Appl Res Ment Retard.* 1986;7:285-298.
45. O'Brien FM, Delanty N, Dineen C et al. Psychogenic non-epileptic seizures in an Irish tertiary referral centre for epilepsy. *Ir J Psychol Med.* 2009;26:174-178.
46. Osman A, Seri S, Cavanna AE. Clinical characteristics of patients with epilepsy in a specialist neuropsychiatry service. *Epilepsy Behav.* 2016;58:44-47.
47. O'Sullivan SS, Spillane JE, McMahon EM et al. Clinical characteristics and outcome of patients diagnosed with psychogenic nonepileptic seizures: A 5-year review. *Epilepsy Behav.* 2007;11:77-84.
48. Owczarek K, Jędrzejczak J. Patients with coexistent psychogenic pseudoepileptic and epileptic seizures: A psychological profile. *Seizure.* 2001;10:566-569.
49. Owczarek K. Anxiety as a differential factor in epileptic versus psychogenic pseudoepileptic seizures. *Epilepsy Res.* 2003;52:227-232.
50. Parra J, Iriarte J, Kanner AM. Are we overusing the diagnosis of psychogenic non-epileptic events? *Seizure.* 1999;8:223-227.
51. Patidar Y, Gupta M, Khwaja G et al. Clinical profile of psychogenic non-epileptic seizures in adults: A study of 63 cases. *Ann Indian Acad Neurol.* 2013;16:157.
52. Plioplys S, Doss J, Siddarth P et al. A multisite controlled study of risk factors in pediatric psychogenic nonepileptic seizures. *Epilepsia.* 2014;55:1739-1747.

53. Rawat VS, Dhiman V, Sinha S et al. Co-morbidities and outcome of childhood psychogenic non-epileptic seizures - An observational study. *Seizure*. 2015;25:95-98.
54. Ribaï P, Tugendhaft P, Legros B. Usefulness of prolonged video-EEG monitoring and provocative procedure with saline injection for the diagnosis of non epileptic seizures of psychogenic origin. *J Neurol*. 2006;253:328-2.
55. Rotge JY, Lambrecq V, Marchal C et al. Conversion disorder and coexisting nonepileptic seizures in patients with refractory seizures. *Epilepsy Behav*. 2009;16:350-352.
56. Sadan O, Neufeld MY, Parmet Y et al. Psychogenic seizures: Long-term outcome in patients with and without epilepsy. *Acta Neurol Scand*. 2016;133:145-151.
57. Ito M, Adachi N, Okazaki M et al. Evaluation of dissociative experiences and the clinical utility of the Dissociative Experience Scale in patients with coexisting epilepsy and psychogenic nonepileptic seizures. *Epilepsy Behav*. 2009;16:491-494.
58. Kuyk J, Swinkels WAM, Spinhoven P. Psychopathologies in patients with nonepileptic seizures with and without comorbid epilepsy: How different are they? *Epilepsy Behav*. 2003;4:13-18.
59. Pillai JA, Haut SR. Patients with epilepsy and psychogenic non-epileptic seizures: An inpatient video-EEG monitoring study. *Seizure*. 2012;21:24-27.
60. Reuber M, Kral T, Kurthen M et al. New-onset psychogenic seizures after intracranial neurosurgery. *Acta Neurochir (Wien)*. 2002;144:901-907.
61. Reuber M, Fernandez G, Bauer J et al. Interictal EEG abnormalities in patients with psychogenic nonepileptic seizures. *Epilepsia*. 2002;43:1013-1020.
62. Reuber M, Qurishi A, Bauer J et al. Are there physical risk factors for psychogenic non-epileptic seizures in patients with epilepsy? *Seizure* 2003;12:561-7.
63. Reuber M, Kurthen M, Fernández G et al. Epilepsy Surgery in Patients With Additional Psychogenic Seizures. *Arch Neurol*. 2002;59:82-86.
64. Shihabuddin B, Abou-Khalil B, Fakhoury T. The value of combined ambulatory cassette-EEG and video monitoring in the differential diagnosis of intractable seizures. *Clin Neurophysiol*. 1999;110:1452-1457.
65. Silva W, Giagante B, Saizar R et al. Clinical features and prognosis of nonepileptic seizures in a developing country. *Epilepsia*. 2001;42:398-401.
66. Slater JD, Brown MC, Jacobs W et al. Induction of Pseudoseizures with Intravenous Saline Placebo. *Epilepsia*. 1995;36:580-585.
67. Syed TU, Arozullah AM, Suciú GP et al. Do observer and self-reports of ictal eye closure predict psychogenic nonepileptic seizures? *Epilepsia*. 2008;49:898-904.
68. Syed TU, Arozullah AM, Loparo KL et al. A self-administered screening instrument for

psychogenic nonepileptic seizures. *Neurology*. 2009;72:1646-1652.

69. Szabó L, Siegler Z, Zubek L et al. A detailed semiologic analysis of childhood psychogenic nonepileptic seizures. *Epilepsia*. 2012;53:565-570.
70. Tamer S.K. The pediatric non-epileptic seizure. *Indian J Pediatrics*. 1997;64:671-6.
71. Tatum WO, DiCiaccio B, Yelvington KH. Cortical processing during smartphone text messaging. *Epilepsy Behav*. 2016;59:117-121.
72. Turner K, Piazzini A, Chiesa V et al. Patients with epilepsy and patients with psychogenic non-epileptic seizures: Video-EEG, clinical and neuropsychological evaluation. *Seizure*. 2011;20:706-710.
73. Vincentiis S, Valente KD, Thomé-Souza S et al. Risk factors for psychogenic nonepileptic seizures in children and adolescents with epilepsy. *Epilepsy Behav*. 2006;8:294-298.
74. Walczak TS, Williams DT, Berten W. Utility and reliability of placebo infusion in the evaluation of patients with seizures. *Neurology*. 1994;44:394-399.
75. Westbrook LE, Devinsky O, Geocadin R. Nonepileptic seizures after head injury. *Epilepsia*. 1998;39:978-982.
76. Whitehead K, O'Sullivan S, Walker M. Impact of psychogenic nonepileptic seizures on epilepsy presurgical investigation and surgical outcomes. *Epilepsy Behav*. 2015;46:246-248.
77. Wissel BD, Dwivedi AK, Gaston TE et al. Which patients with epilepsy are at risk for psychogenic nonepileptic seizures (PNES)? A multicenter case-control study. *Epilepsy Behav*. 2016;61:180-184.
78. Yadav A, Agarwal R, Park J. Outcome of psychogenic nonepileptic seizures (PNES) in children: A 2-year follow-up study. *Epilepsy Behav*. 2015;53:168-173.
79. Acton EK, Doll K, Charles J et al. Respiratory compromise in PNEA patients on the EMU. *Epilepsy Curr* 2012;12. (Suppl 1): 3.173. Abstract.
80. Betts T, Boden S. Diagnosis, management and prognosis of a group of 128 patients with non-epileptic attack disorder. Part I. *Seizure*. 1992;1:19-26.
81. Chu NS. Long-term ambulatory EEG evaluation of epileptic seizures and non-epileptic attacks: a study of 100 patients. *Chin Med J (Taipei)* 1988;42:359-66.
82. Farooq O, Agarwal N, Li P, et al. The presence of non-epileptic seizures in an epilepsy monitoring unit (EMU). *Epilepsy Curr*. 2014;14:1.132. Abstract.
83. Hegermiller-Smith B, Schooff DM. Differences in psychiatric co-morbidities between epileptic and non-epileptic seizures among the veteran population. A study conducted at the Durham VA Medical center. *Epilepsy Curr*. 2012;12. (Suppl 1): 3.096. Abstract.
84. Helmstaedter C. Behavioural features of patients with psychogenic non-epileptic seizures

(PNES). *Epilepsy Curr.* 2015;15:1.283. Abstract.

85. Hernandez AW, Bailey L, Johnson C et al. Prevalence of non-epileptic events in children with and without epilepsy admitted to a level 4 epilepsy center. *Epilepsy Curr.* 2013;13:3.354. Abstract.
86. Jedrzejczak J., Owczarek K., Majkowski J. Psychogenic pseudoepileptic seizures: clinical and electroencephalogram (EEG) video-tape recordings. *Eur J Neurol* 1999;6:473-9.
87. Jovic NJ. Cognitive performance of children and adolescents with pseudoepileptic seizures. *Psihijatrija Danas* 1998;30:423-439.
88. Konikkara JJ, Pacheco J, Van Ness P, et al. Unique characteristics of patients with comorbid epileptic and psychogenic nonepileptic seizures. *Epilepsy Curr.* 2015;15:426-427.
89. Markoula S, De Tisi J, Foong J, Duncan JS. Psychogenic nonepileptic seizures after adult epilepsy surgery. *Epilepsy Curr* 2013;13:3.271. Abstract.
90. Pak A, Anschel DJ, Zhang S. Using the body outline task in epilepsy and nonepileptic seizures. *Epilepsy Curr* 2012;12. (Suppl 1): 3.093. Abstract.
91. Reuber M, Fernández G, Helmstaedter C et al. Evidence of brain abnormality in patients with psychogenic nonepileptic seizures. *Epilepsy Behav.* 2002;3:249-254.
92. Villalobos R, Gonzales E. Non-epileptic seizures in a population of diagnosed pediatric epilepsy patients. *Epilepsy Curr.* 2015;15:12.274. Abstract.
93. Wada JA. Differential diagnosis of epilepsy. *EEG Suppl.* 1985;37:285-311.
94. Ziemba KS, Drazkowski JF. Driving safety in people with non-epileptic events. *Epilepsy Curr* 2015;15:247.
95. Preiss J, Vojtech Z, Haas T. [Is it Possible to Diagnose Pseudoseizures (Non-epileptic Psychogenic Seizures) by Dissociative Experience Scale (DES)?] *Ces a slov Psychiat* 2004;100:197-203.
96. Uhlmann C, Eisele F, Flammer E. [Diagnostik und Therapie von Patienten mit nicht-epileptischen dissoziativen Krampfanfällen in einer Abteilung für Epileptologie] *Z Psychosom Med Psychother.* 2017;57:288-294.
97. Gugliotta SC, Alfa R, Lagana A MA. [Presenza in carico e valutazione psichica di una popolazione di pazienti con Crisi Psicogene (PNES) Psychological evaluation and management of patients with psychogenic non-epileptic seizures (PNES)]. *Bol Lega Ital Epil.* 2013;145:35-43.
98. Turner K, Piazzini A, Barbieri V, et al. [Psychiatric and cognitive profiles of patients with epilepsy and psychogenic non-epileptic seizures (PNES)]. *Bol Lega Ital Epil* 2010;140:40-2.

99. Galimberti C, Ratti M, Murelli R, et al. [Non-epileptic psychogenic seizures: Clinical and psychological findings]. *Bol. Lega It. Epil.* 1998;327-8.
100. Hisano T, Adachi N, Onuma T et al. [Clinical characteristics of 10 epileptic patients with pseudoseizures]. *J. Jpn. Epil. Soc.* 1992;10:209-14.
101. Ristic AJ, Petrovic I, Vojvodic N et al. [Phenomenology and psychiatric origins of psychogenic non-epileptic seizures]. *Srp Arh Celok Lek* 2004;132:22-27.
102. van der Peet J, Swinkels W, Duijsens I. [Personality disorders in patients admitted to an epilepsy clinic] *Tijdschrift voor Psychiatrie* 2001;43:683-91.
103. Meierkord H, Will B, Fish D et al. The clinical features and prognosis of pseudoseizures diagnosed using video-EEG telemetry. *Neurology.* 1991;41:1643-1646.
104. Lesser RP, Lueders H, Dinner DS. Evidence for epilepsy is rare in patients with psychogenic seizures. *Neurology.* 1983;33:502-504.
105. Krumholz A, Niedermeyer E. Psychogenic seizures: A clinical study with follow-up data. *Neurology.* 1983;33:498-502.
106. Barry E, Krumholz A, Bergey GK et al. Nonepileptic posttraumatic seizures. *Epilepsia.* 1998;39:427-431.
107. Mayor R, Howlett S, Grünwald R et al. Long-term outcome of brief augmented psychodynamic interpersonal therapy for psychogenic nonepileptic seizures: Seizure control and health care utilization. *Epilepsia.* 2010;51:1169-1176.
108. Lancman ME, Brotherton TA, Asconapé JJ et al. Psychogenic seizures in adults: a longitudinal analysis. *Seizure.* 1993;2:281-286.
109. Lelliott PT, Fenwick P. Cerebral pathology in pseudoseizures. *Acta Neurol Scand.* 1991;83:129-132.
110. Henry TR, Drury I. Non-epileptic seizures in temporal lobectomy candidates with medically refractory seizures. *Neurology.* 1997;48:1374-82.
111. Cohen RJ, Suter C. Hysterical seizures: Suggestion as a provocative EEG test. *Ann Neurol.* 1982;11:391-395.
112. Baslet G, Roiko A, Prensky E. Heterogeneity in psychogenic nonepileptic seizures: Understanding the role of psychiatric and neurological factors. *Epilepsy Behav.* 2010;17:236-241.
113. Benbadis SR, Lancman ME, King LM et al. Preictal pseudosleep: A new finding in psychogenic seizures. *Neurology.* 1996;47:63-67.
114. Kotagal P, Costa M, Wyllie E et al. Paroxysmal nonepileptic events in children and adolescents. *Pediatrics.* 2002;110:e46.
115. Kanner AM, Parra J, Frey M et al. Psychiatric and neurologic predictors of psychogenic

- pseudoseizure outcome. *Neurology*. 1999;53:933-938.
116. King DW, Gallagher BB, Murvin AJ et al. Pseudoseizures: diagnostic evaluation. *Neurology*. 1982;32:18-23.
 117. Lempert T, Schmidt D. Natural history and outcome of psychogenic seizures: a clinical study in 50 patients. *J Neurol*. 1990;237:35-38.
 118. Seneviratne U, Briggs B, Lowenstern D et al. The spectrum of psychogenic non-epileptic seizures and comorbidities seen in an epilepsy monitoring unit. *J Clin Neurosci*. 2011;18:361-363.
 119. Gulick TA, Spinks IP, King DW. Pseudoseizures: ictal phenomena. *Neurology*. 1982;32:24-30.
 120. Sutula TP, Sackellares JC, Miller JQ et al. Intensive monitoring in refractory epilepsy. *Neurology*. 1981;31:243-247.
 121. Leis AA, Ross MA, Summers AK. Psychogenic seizures: ictal characteristics and diagnostic pitfalls. *Neurology*. 1992;42:95-99.
 122. Jedrzejczak J, Owczarek K. [Psychogenic pseudoepileptic seizures: Analysis of the clinical data in 1990-1997] *Krankenhauspsychiatrie* 1999;10:36-40.
 123. Paquet JM, Turpin JC, Luaute JP et al. [Diagnosis of pseudo-seizures using prolonged video-coupled EEG]. *Ann. Med.-Psychol.*, 1998;156:631-4.
 124. Fujimoto S, Mizuno K, Takasaka Y et al. [Ictal electroencephalographic recordings of patients with seizure]. *Rinsho Byori* 1995;43:865-870.
 125. Holmes GL, Sackellares JC, McKiernan J et al. Evaluation of childhood pseudoseizures using EEG telemetry and video tape monitoring. *J Pediatr*. 1980;97:554-558.
 126. Duncan R, Graham CD, Oto M et al. Primary and secondary care attendance, anticonvulsant and antidepressant use and psychiatric contact 5-10 years after diagnosis in 188 patients with psychogenic non-epileptic seizures. *J Neurol Neurosurg Psychiatry*. 2014;85:954-958.
 127. Berg AT, Altalib HH, Devinsky O. Psychiatric and behavioral comorbidities in epilepsy: A critical reappraisal. *Epilepsia*. 2017;58:1123-1130.
 128. Galtrey CM, Mula M, Cock HR. Stress and epilepsy: Fact or fiction, and what can we do about it? *Pract Neurol*. 2016;16:270-278.
 129. Lang JD, Taylor DC, Kasper BS. Stress, seizures, and epilepsy: Patient narratives. *Epilepsy Behav*. 2018;80:163-172.

Fig. 1. PRISMA flow diagram for the systematic review process.

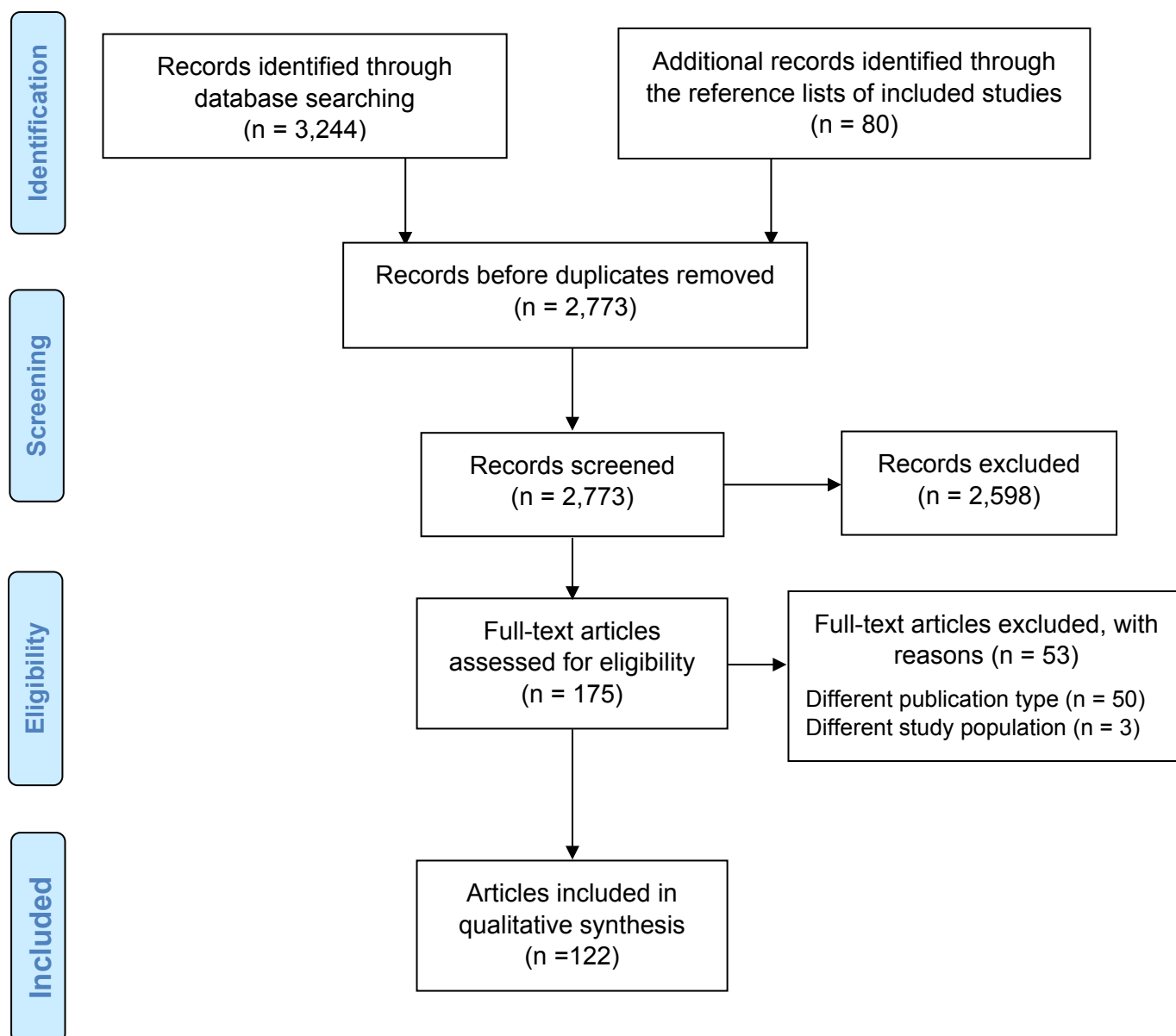


Fig.2. The frequency of epilepsy in patients with PNES

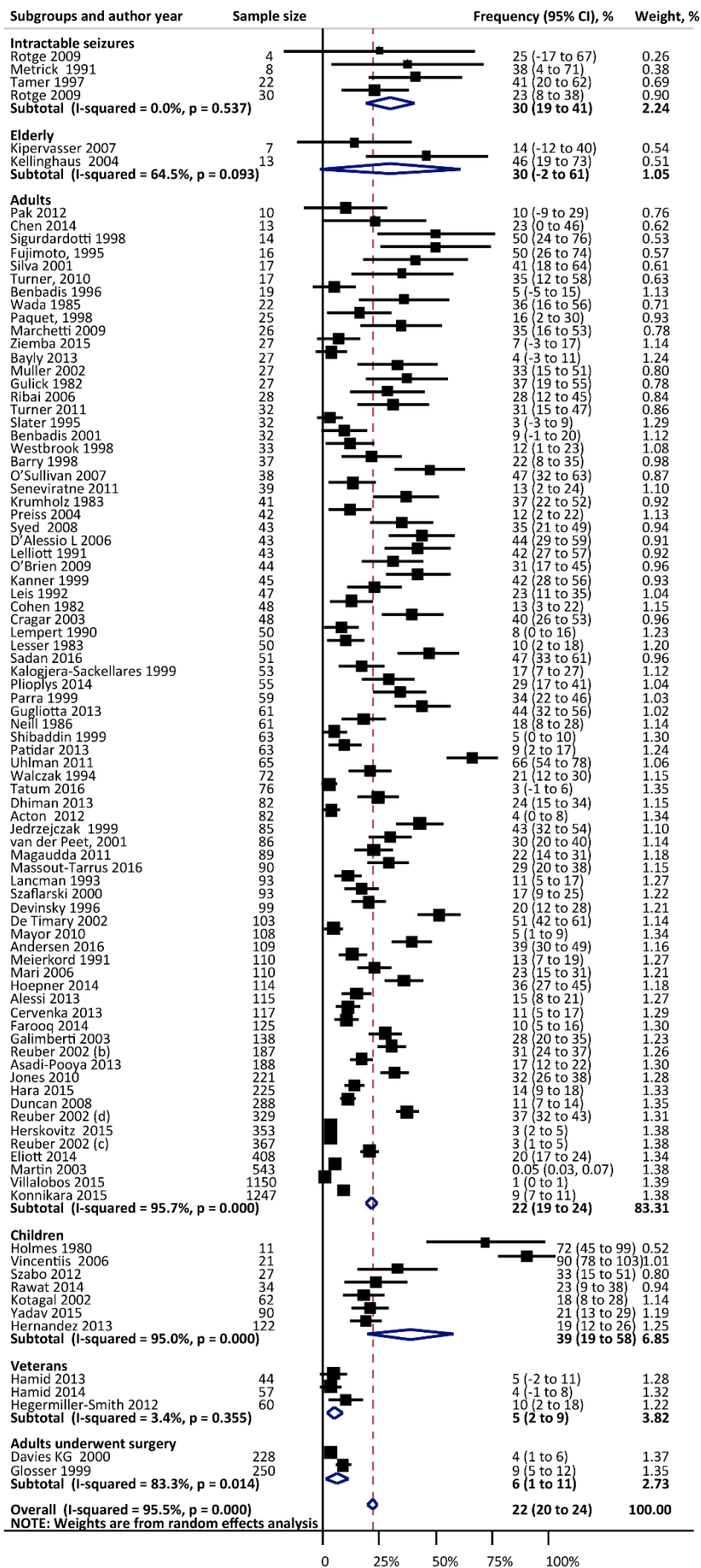


Fig. 3. The frequency of PNES in patients with epilepsy

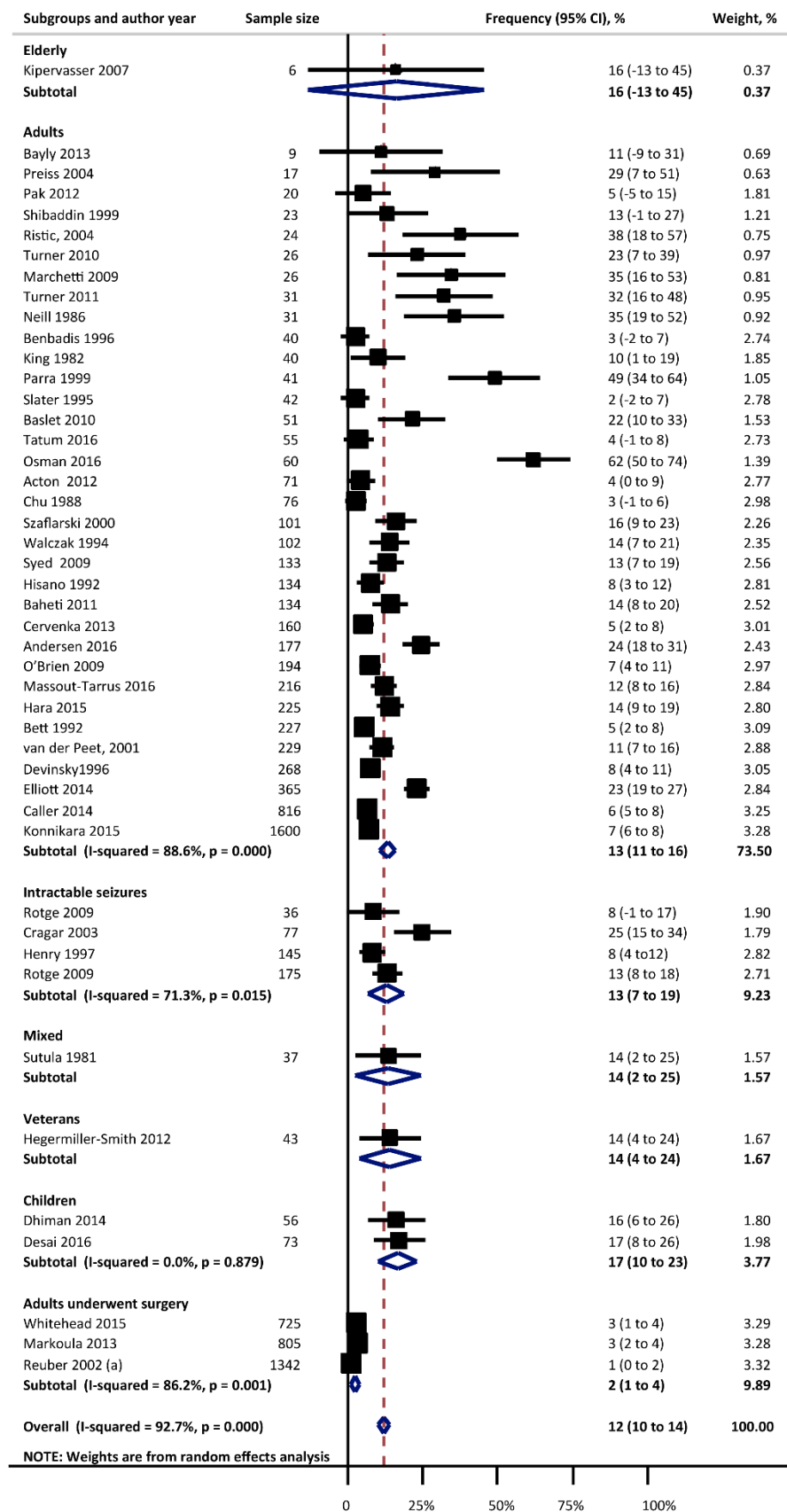


Table 1. Age, sex, age, disease duration and education level in patients with dual diagnosis, in comparison to those with PNES and/or ES

	D'Alessio 2006 ¹⁸	Mari 2006 ⁴⁰	Kuyk 2003 ⁵⁸	Asadi-Pooya 2013 ¹²	Hara 2015 ³¹	Hoepner 2014 ³³	O'Sullivan 2017 ⁴⁷	Sadan 2016 ⁵⁶	Cragar 2003 ¹⁷	Elliott 2014 ²⁶	Galimberti 2003 ²⁷	Jovik 1998 ^{**87}	Reuber 2003 ⁶²	Markoula [*] 2013 ⁸⁹	Konnikara 2015 ⁸⁸	De Timary 2002 ²⁰	Duncan 2008 ²⁵	Turner 2011 ⁷²	Wissel 2016 ⁷⁷	Glosser 2016 ^{*28}
Total N in the study	43	110	85	188	225	114	38	51	106	689	138	71	180	805	2738	103	288	66	138	250
N PNES	24	85	60	156		73	20	27	29	324	100	17	90		1488	50	257	22	46	228
N Epilepsy	-	-	-	-	194				58	281		30		779	1135			21	46	
N Dual	19	25	25	32	31	41	18	24	19	84	30	24	90	25	112	53	31	10	46	22
Age	<	<	>	=	=	=	=	=	=	=	=	=	=	=	=	=	=	=	=	=
Age at onset		=	=		=	<	=	=	<	= ES	>	>	= ES			<	<	=		>ES
Male	>	=	=	=		=	=	=	=	= ES	<ES	<PNES	= ES		<	=		= ES		<ES
Disease duration	<PNES	>PNES			=	<PNES			<ES	< ES	=	=	< ES	< ES				=	>ES	
Education level		=	=	=	<PNES				>PNES	= ES	= ES	= ES						=		=

< denotes those with dual diagnosis are younger than those with PNES or lower proportion of males among those dual diagnosis than those with PNES;

= Those with dual diagnosis are at same age/gender balance/disease duration/education level as those with PNES;

> Those with dual diagnosis older/more males than those with PNES;

< **ES** Those with dual diagnosis younger/fewer males/had shorter disease duration than those with ES;

= Those with dual diagnosis same age/gender balance/disease duration as those with ES,

>**ES** older/disease duration longer in those with dual diagnosis then in ES,

>**PNES** education level was higher/disease duration was shorter in patients with PNES than with dual diagnosis,

<**PNES** disease duration was shorter/education level was lower in patients with dual diagnosis than with PNES

* - included patients who had undergone resective epilepsy surgery, ** - studies recruiting children.

Table 2. Comparative analysis of epilepsy location in patients with dual diagnosis and epilepsy

Study	N/N*	Dual diagnosis	Epilepsy
Pillali 2012 ⁵⁹	38/78	Frontal lobe	Temporal lobe
Konnikara 2015 ⁸⁸	112/1488	No difference**	
Wissel 2016 ⁷⁷	46/46	Right hemisphere	-
Reuber 2003 ⁶²	90/90	No difference***	

* - number of patients with dual diagnosis/epilepsy

** - temporal lobe epilepsy was diagnosed in 79% (dual) and 75% (epilepsy) respectively

*** - more generalized epileptiform interictal changes were registered in patients with dual diagnosis

Table 3. Psychiatric comorbidities in patients with dual diagnosis, PNES and epilepsy

Study	Dual	PNES	Epilepsy	Findings
Sadan 2016 ⁵⁶	24	27		PNES=dual diagnosis
Turner 2011 ⁷²	10	22	21	ES=PNES=dual diagnosis
O'Sullivan 2007 ⁴⁷	18	20		PNES=dual diagnosis
Wissel 2016 ⁷⁷	46	46	46	ES<dual diagnosis; PNES< dual diagnosis depression, anxiety and stressor as a trigger of a seizure
Helmstaedter 2015 ⁸⁴	335			dual diagnosis >ES general behavioral problems
Owzcarek 2003 ⁴⁹	152			dual diagnosis >ES anxiety and neuroticism
Ito 2009 ⁵⁷	165			dual diagnosis >ES dissociation
Eliott 2014 ²⁶	84	32	281	dual diagnosis >PNES as depression, anxiety, bipolar disorder and personality disorder
Kuyk 2003 ⁵⁸	25	60		dual diagnosis >PNES personality disorders; dual diagnosis <PNES somatoform disorder
D'Alessio 2006 ¹⁸	19	24		PNES=dual diagnosis

Table e–1: Description of search strategy.

Database	Search strategy	Limits
1) Medline	1. exp Epilepsy/ 2. epilep*.tw. 3. non-epilep* seizure*.tw. 4. non*epilep* seizure*.tw. 5. non-epilep* attack*.tw. 6. non*epilep* attack*.tw. 7. non-epilep* event*.tw. 8. non*epilep* event*.tw. 9. non*epilep* attack disorder*.tw. 10. non-epilep* attack disorder*.tw. 11. psychogenic seizure*.tw. 12. functional seizure*.tw. 13. pseudoseizure*.tw. 14. pseudoepilep* seizure*.tw. 15. Psychophysilogic Disorders/ 16. 1 or 2 17. or / 3-15 18. 16 and 17	Human
2) EMBASE	1. exp epilepsy/ 2. epilep*.tw. 3. psychosomatic disorder/ 4. non-epilep* seizure*.tw. 5. non*epilep* seizure*.tw. 6. non-epilep* attack*.tw. 7. non*epilep* attack*.tw. 8. non-epilep* event*.tw. 9. non*epilep* event*.tw. 10. non*epilep* attack disorder*.tw. 11. non-epilep* attack disorder*.tw. 12. psychogenic seizure*.tw. 13. functional seizure*.tw. 14. pseudoseizure*.tw. 15. pseudoepilep* seizure*.tw. 16. psychogenic nonepileptic seizure/ 17. 1 or 2 18. or / 3-15 19. 17 and 18	Human AND Exclude medline journals
3) CINAHL	S1. epilep* S2. MH Epilepsy+ S3. MH Psychophysilogic Disorders+ S4. non*epilep* seizure* S5. non-epilep* attack* S6. non-epilep* event* S7. non*epilep* event* S8. non-epilep* attack disorder* S9. psychogenic seizure* S10. S1 OR S2 S11. S3 OR S4 OR S5 OR S6 OR S7 OR S8 OR S9 S12. S10 AND S11	Human AND Exclude MEDLINE records AND Peer reviewed
4) PsycINFO	1. exp Epilepsy/ 2. epilep*.tw. 3. non-epilep* seizure*.tw. 4. non*epilep* seizure*.tw. 5. non-epilep* attack*.tw. 6. non*epilep* attack*.tw. 7. non-epilep* event*.tw. 8. non*epilep* event*.tw. 9. non*epilep* attack disorder*.tw. 10. non-epilep* attack disorder*.tw. 11. psychogenic seizure*.tw. 12. functional seizure*.tw. 13. pseudoseizure*.tw. 14. pseudoepilep* seizure*.tw. 15. Psychophysilogic Disorders/ 16. 1 or 2 17. or / 3-15 18. 16 and 17	Human
tw denotes title and abstract. terms end up with / are MeSH or Emtree subject headings Searching was done on 11 Dec 2016.		